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Trends in prostate cancer incidence between 1996 and 2013 in two Swiss regions by age, grade and T-stage

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Abstract

Purpose

To investigate differences in prostate cancer incidence between two distinct Swiss regions from 1996 to 2013 stratified by age group, grade and T-stage.

Methods

The dataset included 17,495 men living in Zurich and 3,505 men living in Ticino, diagnosed with prostate cancer between 1996 and 2013. We computed age-standardized incidence rates per 100,000 person-years using the European Standard Population. Trends were assessed using JoinPoint regression analysis Software.

Results

Age-standardized incidence rates were generally higher in Zurich compared to Ticino but the difference decreased over time. Incidence rates increased significantly up to 2002 in Zurich and 2007 in Ticino and then decreased. A statistically significant increase was observed for men aged <65 years, for grade 3 tumors, and for T-stage 2 and 3 tumors. The largest decrease was seen for grade 1 tumors. Furthermore, the incidence of tumors of unknown grade or T-stage decreased significantly in both regions.

Conclusions

The trends in prostate cancer incidence rates were similar in both regions, although on a higher level in Zurich compared to Ticino. However, the difference decreased over time. The distribution of T-stage and grade did not explain the difference in incidence rates. Different use of opportunistic screening may play a role.

Keywords:

prostate cancer, Switzerland, time trend, staging, grading

Introduction

As in many Western countries, prostate cancer is the most common cancer among men in Switzerland [1]. However, differences in prostate cancer incidence and mortality have been observed between the German-speaking and the Italian-speaking part of Switzerland [2,3]: Age-standardized incidence rates were 124/100,000 person-years in the German-speaking and 96/100,000 person-years in the Italian-speaking part between 2009 and 2013, age-standardized mortality rates were 24/100,000 person-years in the German-speaking and 18/100,000 person-years in the Italian-speaking part during the same time period [4]. The reasons for these differences are unclear. Cross-sectional data from the Swiss Health Surveys propose some differences in lifestyle habits potentially associated with risk of prostate cancer between men living in the German-speaking and the Italian-speaking part [5]. For example, living in the Italian region was associated with "risk-reducing" diet, such as lower consumption of dairy products and meat and high fish consumption [5]. However, other potentially protective behaviors were more common in the German-speaking part (e.g. physical activity, vegetable consumption, low alcohol consumption) [5].

There is no organized prostate cancer screening program in Switzerland, but opportunistic screening is frequent and often recommended to men aged 50 years and older by their physicians or urologists [6]. Differences in screening practices may also explain some of the differences in prostate cancer incidence observed in Zurich and Ticino. To further address these differences, we examined incidence trends from 1996 to 2013 by age group, grade and T-stage using data from the cantonal cancer registries of Zurich (German-speaking part) and Ticino (Italian-speaking part).

Methods

Data

The collection of cancer registry data is not yet mandatory in Switzerland, however, several regions have set up cantonal cancer registries starting in the 1970s. The cancer registry of the cantons of Zurich and Zug is the largest Swiss registry covering a population of roughly 1.6 million inhabitants. The registry for Zurich was established in 1980, the one for Zug in 2011. The cancer registry of the canton of Ticino was established in 1996 and covers a population of about 350’000 inhabitants. To be included in a canton’s cancer registry a patient has to live in the respective canton, even if they are treated in another canton. In order to be comparable, incidence data from 1996 to 2013 were included for both cantons.

The dataset includes data on date of diagnosis, basis of diagnosis (death certificate only (DCO), clinical, clinical investigation, specific tumor markers, cytology, histology of metastasis, histology of primary tumor, unknown), age at diagnosis, tumor grade, as well as T-stage.

The dataset for the canton of Zurich included 17,535 men who were diagnosed with prostate cancer (C61.9 ICD-O, 3rd edition) between 1996 and 2013 and lived in the canton of Zurich. Patients with unknown basis of diagnosis (n=2), or with a histology of metastasis as basis of diagnosis (n=38) were excluded, resulting in a final dataset of 17,495 men. The dataset for the canton of Ticino included 3536 men who were diagnosed with prostate cancer between 1996

and 2013 and lived in the canton of Ticino. Patients with unknown basis of diagnosis (n=1) and with a histology of metastasis as basis of diagnosis (n=30) were excluded, resulting in a final dataset of 3505 men.

For Zurich, the percentage of death certificate only cases (DCO) was 2.3% for the period 1996–2013 and the percentage of morphologically verified cases (MV) 93.0%. For Ticino, the percentage of DCO cases was 1.5% and the percentage of MV cases 91.1%.

Statistical analyses

Age-standardized incidence rates per 100,000 person-years were computed using the 1976 European Standard Population [7] and mid-year population estimates. For age-stratified analyses, we used three age groups: <65 years, 65-74 years, and ≥75 years. Because the corresponding Gleason Score (GS) is often missing in our data, we used tumor grade instead of GS. Grade was defined as grade 1 (well differentiated), grade 2 (moderately differentiated), grade 3 (poorly differentiated), and unknown grade. T-stage (based on TNM) was stratified as T-stage 1, T-stage 2, T-stage 3, T-stage 4, and unknown T-stage. We chose pathological T-stage if available, otherwise clinical T-stage. StataSE 14 (Stata Corporation, College Station, TX, USA) was used to prepare the incidence files by calendar year and age group/grade/T-stage.

Incidence time trends were assessed using joinpoint regression analysis (JoinPoint Trend Analysis Software Version 4.3.1.0, April 2016; US National Cancer Institute, Division of Cancer Control & Population Sciences, Surveillance Research Program). This method is used to determine the number of joinpoints that are adequate for assessing significant changes in incidence trends over time. The analysis starts with 0 joinpoints (corresponding to a straight regression line) and tests whether one or more joinpoints are significant. The Grid Search Method and the Monte Carlo permutation method with 4499 replicates and a significance level of 0.05 were used [8]. We defined the maximum number of joinpoints as three, the minimum number of observations from a joinpoint to either end of the data as three, and the minimum number of observations between two joinpoints as six (including any joinpoint that falls on an observation) [8]. The dependent variable was the age-standardized incidence rate, the independent variable was calendar year, and age category/grade/T-stage were defined as by-variables. Model estimates included the number of joinpoints as well as the slopes and intercepts for each regression line between two joinpoints, in addition to the annual percentage change (APC) for each identified trend. Furthermore, the program provides average annual percentage changes (AAPC), a summary measure over the whole period of observations (1996-2013). Log-transformation was used because of non-normality of the data. The AAPC are presented with 95% confidence intervals (95% CI). A joinpoint model was fit for overall prostate cancer incidence, then separate models were fit for subgroups by age, grade and T-stage.

Results

We included 17,495 and 3505 prostate cancer cases for the cantons of Zurich and Ticino, respectively (Table 1). Grade was unknown for 10.6% of the included cancer cases in Zurich and for 13.3% in Ticino; for T-stage percentages "unknown" were 28.5% for Zurich and 27.7% for Ticino. Fig. 1 shows the age-standardized incidence rates between 1996 and 2013 for Zurich and Ticino. The numbers and crude, age-standardized and age-stratified incidence rates are shown in Electronic Supplementary Material Table 1. In 1996, age-standardized incidence rates were almost 40% lower in Ticino compared to Zurich (76.9/100,000 versus 122.8/100,000) and thus, the increase observed in both cantons started on a much lower level in Ticino. According to joinpoint regression analysis, the age-standardized incidence rate increased between 1996 and 2002 in Zurich (APC = 3.1, 95% CI 1.4, 5.0) and between 1996 and 2007 in Ticino (APC = 6.0, 95% CI 3.3, 8.8), indicating that the increase was steeper and lasted five years longer in Ticino. Consequently, the incidence rates in the two cantons were on a similar level in 2007 (129.8/100,000 in Ticino versus 136.1/100,000 in Zurich). In Zurich, the incidence rate started to decrease in 2002 (APC = -1.3, 95% CI -2.3, -0.3) with a more pronounced decrease starting in 2011 (APC = -10.5, 95% CI -18.8, -1.2). In Ticino, the age-standardized incidence rate started to decrease in 2007 (APC = -5.2, 95% CI -10.1, -0.1). In 2013, the age-standardized incidence rate was about 20% lower in Ticino compared to Zurich (82.6/100,000 versus 105.1/100,000). The detailed results from the joinpoint analyses, also stratified by age group, grade and T-stage, are displayed in Electronic Supplementary Material Table 2.

Table 1. Prostate cancer cases reported for the cantons of Zurich and Ticino (Switzerland) between 1996 and 2013

	Zurich		Ticino	
	N	%	N	%
Total cases	17,495	100	3,505	100
Age at diagnosis				
<65 years	5,005	28.6	899	25.7
65-74 years	6,992	40.0	1,378	39.3
≥75 years	5,498	31.4	1,228	35.0
Grade				
1	1,524	8.7	167	4.8
2	7,574	43.3	1,238	35.3
3	6,547	37.4	1,632	46.6
unknown	1,850	10.6	468	13.3
T-stage				
1	4,325	24.7	386	11.0
2	5,758	32.9	1,330	37.9
3	2,107	12.0	725	20.7
4	323	1.9	94	2.7
unknown	4,982	28.5	970	27.7

Table 2 displays the AAPC for the separate joinpoint models according to canton, age group, grade, and T-stage. A significant overall increase was seen in the youngest age group (<65 years) in both cantons and in the intermediate age group (65-74 years) in Ticino only, and a significant decrease in the oldest age group (≥75 years) in Zurich only (Fig. 2). Both tumors with unknown grade and with unknown T-stage decreased significantly in Zurich and Ticino between 1996 and 2013. The most pronounced overall decrease was observed for grade 1 tumors in both cantons (Fig. 3), and this decrease was especially pronounced after 2003 (Zurich) and 2002 (Ticino, Electronic Supplementary Material Table 2). AAPC was also negative for grade 2 tumors, although only significant for Zurich and mainly driven by a steep decrease starting in 2007. Grade 3 tumors increased significantly, however, in Ticino the increase in these tumors was interrupted in 2007 followed by a (non-significant) decrease. We observed significant overall increases for T-stage 1, 2 and 3 tumors in both cantons with most pronounced increases for T-stage 1 tumors. To some extent, the increase in T-stages 1-3 tumors was driven by the decrease in the proportion of unknown T-stage tumors. A decrease was observed in T-stage 4 tumors (Fig. 4), although only significant for Ticino.

Table 2. Average annual percentage change (AAPC) and 95% confidence intervals (95% CI) stratified by age group, grade and T-stage based on joinpoint regression analysis, 1996-2013, Zurich and Ticino (Switzerland)

	Zurich		**Ticino**	
	AAPC	**95% CI**	**AAPC**	**95% CI**
overall	-0.9	-2.1, 0.3	1.9	-0.4, 4.2
<65 years	2.0	0.5, 3.5	5.5	1.0, 10.1
65-74 years	0.3	-1.0, 1.7	2.4	0.3, 4.6
≥75 years	-3.8	-4.2, -3.3	-1.2	-2.5, 0.2
Grade 1	-23.9	-27.7, -19.9	-19.7	-26.6, -12.0
Grade 2	-4.8	-6.7, -2.9	-1.6	-3.5, 0.5
Grade 3	8.3	6.8, 9.8	11.6	7.2, 16.3
Grade unknown	-4.2	-7.9, -0.4	-5.2	-9.2, -1.1
T-stage 1	10.0	6.4, 13.7	19.2	4.9, 35.4
T-stage 2	3.6	0.2, 7.1	8.0	3.6, 12.6
T-stage 3	3.7	2.1, 5.3	2.6	0.0, 5.3
T-stage 4	-2.3	-5.3, 0.9	-6.3	-9.4, -3.0
T-stage unknown	-14.7	-17.9, -11.3	-9.1	-12.4, -5.7

AAPC, average annual percent change; 95% CI, 95% confidence interval

When stratifying the analyses by age group and grade/T-stage simultaneously (data not shown), a significant decrease in grade 1 tumors with AAPC of about 20% in Zurich and 15% in Ticino was present in all three age groups. Grade 2 tumors decreased in both cantons mainly in the older age groups with no significant change in AAPC for men <65 years of age. The overall observed increase in grade 3 tumors was present in all three age groups and both cantons with larger AAPC in the two younger age groups. There was a tendency towards decrease in unknown grade tumors in all age groups and both cantons, although mostly not statistically significant.

A significant increase in T-stage 1 tumors was observed in all age groups and both cantons with highest AAPC of around 17% in the youngest age group in both Zurich and Ticino (data not shown). Similarly, T-stage 2 tumors increased in all age groups and both cantons, but the AAPC were in a smaller range and not significant for those ≥75 years in Zurich. A significant increase in T-stage 3 tumors was present in all age groups in Zurich, but in Ticino, a significant increase was only seen in the youngest age group. A significant decrease in T-stage 4 tumors was present in the youngest age group in Zurich and the intermediate age group in Ticino with no significant AAPC in the other age groups. Finally, the decrease in tumors of unknown T-stage was significant in all age groups except in the youngest age group in Ticino. The AAPC tended to be higher in Zurich compared to Ticino.

Discussion

In 1996, the incidence of prostate cancer was higher in Zurich (German-speaking part) compared to Ticino (Italian-speaking part), but at the end of observation in 2013, the difference between the two cantons was smaller. One explanation for the larger difference in 1996 may be that the cancer registry in Zurich started in 1980, while for the cancer registry Ticino 1996 was the first year of data registration, and under-reporting is typically observed right after the start of a Cancer Registry [9]. Despite the different starting levels, our analyses showed an overall similar time trend in both cantons with an increase in the early phase of the observed period and a decrease in the later phase. The increase in Ticino was steeper and went on until 2007, while in Zurich the trend from an increasing to a decreasing pattern occurred in 2002. The stratified analyses by age group, grade and T-stage did not reveal systematic differences between the two cantons, except for a different T-stage distribution with a higher proportion of T-stage 1 cancer cases in Zurich than in Ticino. This may reflect different opportunistic screening patterns. Another explanation for the observed stage migration with an increase in smaller tumors and a decrease in larger tumors may be a change in the number of prostate biopsies with extended pattern prostate biopsy templates resulting in the detection of smaller volume tumors [10]. In both cantons, incidence rates increased in the youngest age group, which may also be related to screening with prostate cancers being detected earlier in life.

Besides screening, a difference in lifestyle factors associated with prostate cancer may partly explain the lower incidence rates in Ticino. There is evidence for a protective effect of low dairy product and meat consumption, and high fish, vegetable and fruit consumption on the risk of prostate cancer [11,12]. Furthermore, there seems to be a small inverse association between physical activity and prostate cancer risk [13]. Men living in the Italian-speaking part had a lower consumption of dairy products and meat and a higher fish consumption compared to men living in the German-speaking part [5], which may partly explain the lower incidence rates in Ticino. However, physical activity was higher in the German-speaking part [5].

Comparison with other studies

In a large evaluation of 43 populations worldwide [14], which also included data from the Swiss registries of Geneva and St. Gall-Appenzell, a moderate increase in prostate cancer incidence in these two Swiss registries between the 1980s and 2000 was observed, which was followed by a plateau. This was mostly similar across age groups, with the exception of a decrease in incidence rates in men ≥75 years of age starting at the end of the 1990s, whereas an increase was still observed in men 45-54 years old that started in the mid-1990s. In the 1990s, the increase in incidence was strongest in men 55-64 years old (APC 11.4%). This pattern was similar in another publication, which only included data from the Geneva cancer registry [15]. A more recent study on temporal patterns of prostate incidence and mortality in 36 countries showed an increase in the incidence of prostate cancer in Switzerland between 1998 and 2007 [16], which is in line with our results.

Comparing our data from the German-speaking part (Zurich) with data from Germany, which is similar regarding language and culture, a study based on data form the Cancer Registry Schleswig-Holstein reported an incidence rate of 106.1/100,000 in 1999-2005 [17]. Similar to the pattern in Zurich, incidence increased up to 2003 (from about 80/100,000 in 1999 to about 130/100,000 in 2003) and decreased thereafter [17]. About 64% were grade 2 und 27% grade 3 tumors [17] compared to 43% and 37% in Zurich, respectively. In a German study covering 12 cancer registries (33% of the German population), a decrease in incidence rate between 1999 and 2010 similar to our results was observed in men aged ≥75 years [18]. However, the largest increase in the German study was reported for men aged 65-74 years [18] while we observed no significant change in this age group and the largest increase in men under the age of 65 years.

Comparing our data from the Italian-speaking part (Ticino) with data from Italy (which is similar regarding language and culture), a study estimating trends in Italy reported a comparable pattern in incidence rates with around 60/100,000 in the mid-1990s increasing to just under 100/100,000 in 2005 and decreasing thereafter [19]. Similar increasing trends up to 2005 were estimated for different regions in Italy [20]. Data from the Tuscany cancer registry in central Italy showed much higher incidence rates but a similar pattern, with an increase from about 120/100,000 in 1985 to almost 290/100,000 in 2003 (APC =4.9, 95% CI 4.3, 5.4) and a non-significant decrease thereafter (APC = -3.9, 95% CI -15.3, 8.9) [21].

The changes in prostate cancer incidence rates in Switzerland and other Western countries may be due to changes in prostate cancer screening behavior. In the United States, the US Food and Drug Administration (FDA) approved Prostate-specific Antigen (PSA) testing in 1986 as a means of monitoring prostate cancer progression, and ideally tumor detection, in conjunction with digital rectal exam (DRE) in men ≥50 years of age in 1994 [22]. The situation in Switzerland is different, as in 2011, the Swiss Medical Board advised against PSA testing for prostate cancer in men without symptoms or without a family history based on cost-benefit analyses [23]. However, opportunistic screening is frequent in Switzerland [6]. In an analysis of opportunistic prostate cancer screening use in Switzerland based on the Swiss Health Surveys between 1992 and 2012, the prevalence of ever use among men ≥50 years of age increased from 55.3% in 1992 to 70.0% in 2012 [6]. The use of prostate cancer screening in the last two years before the respective survey increased from 32.6% to 42.4% [6]. Interestingly, until 2002,

participation was higher in the German-speaking part of Switzerland than in the Italian part (1992: 34.4% vs. 26.6% for prostate cancer examination in the last two years; 2002: 36.0 vs. 34.4%), but in 2007 and 2012, participation in the German-speaking region was lower (41.4% vs. 46.6% and 40.7% vs. 48.5%, respectively). Thus, the increase in men having had a PSA test in the two years preceding the survey was larger in the Italian- than in the German-speaking region of Switzerland, which corresponds to a higher increase of T-stage 1 tumors in Ticino compared to Zurich during the observation period.

Changes by stage

Stage-specific changes in incidence rates have not yet been reported for Switzerland. In a Norwegian study covering 1980-2010, the incidence of prostate cancer increased, in particular in the period 2001 to 2010, i.e. after the introduction of PSA screening [24]. However, the changes differ by age and stage of the disease, such that in men 50-64 and 65-74 years old, the incidence of localized and regional tumors increased whereas that of distant tumors decreased, which is in line with our results. A Swedish study which evaluated cancer registry data between 1996 and 2005 reported a rapid increase in the incidence of T1c tumors, whereas the incidence rates of T1a/T1b and T3/T4 tumors decreased slightly and T2 tumors increased moderately [25].

In a Dutch study, covering the period 1989-2006, incidence of cT1c tumors increased steadily since its introduction into the TNM system in 1993 [26]. This increase was most strongly seen in men younger than 74 years of age. In men ≥75 years of age, the incidence of cT1c cases increased slowly but steadily [26]. In a British study, an increase in prostate cancer incidence was reported between 2000 and 2010 for all age groups except for men >80 years of age [27]. Both localized and advanced tumor incidence increased, but the latter to a smaller extent.

According to a German study, the proportion of localized tumors increased from 52% in the period 1998-2000 to 68% in 2007-2010, while the proportion of regional and distant tumors decreased from 31% to 23% and from 17% to 10%, respectively, in the same time period [18]. The Munich study reported increases in T-stage 1 and 2 tumors and a decrease in T-stage 4 tumors, which is in line with our results, however a decrease in T-stage 3 tumors was observed in Munich while in Zurich we observed an increase in these tumors [28]. An Italian study reported a sharp increase in T-stage 1 tumors between the time period 1996-1999 and 2005-2007 from 35% to 59% and a decrease in T-stage 3-4 tumors from 33% to 11% [29]. Another Italian study focusing on three regions reported an increase in localized tumors only in Varese, while these tumors remained stable in Genova and decreased in Modena between the mid-1980s and 1990s [30]. On the other hand, regional tumors increased in all three regions while distant tumors decreased [30].

Changes by grade

The comparison with other studies regarding grade is not straightforward because most other studies used GS to define grade. The Swedish study observed that the vast majority of cases (55-65%) were those with a GS 5-6. Between 2000 and 2005, the incidence of GS 2-4 tumors

decreased, whereas GS 5-6 and GS 7 tumors increased. Only a slight increase was seen for GS 8-10 [25]. In the British analyses, the incidence of GS ≤6 tumors decreased, while cases with GS ≥7 increased [27]. In the Dutch study [26], the number of well-differentiated tumors increased until 1995 and then decreased until 2003. A sharp increase was noted thereafter, which is very likely due to the Dutch Cancer Registries switching from the WHO grading system to the GS system around 2004. The Munich study also reported a decrease for GS 2-4 and 5-6 tumors and a large increase in GS 7 tumors, while there was no change in GS 8-10 tumors [28]. One of the Italian studies reported a decrease in GS 2-4 tumors (from 19% to 8%) but an increase in GS 5-6 tumors (from 39% to 52%), while GS 7 tumors increased only slightly and GS 8-10 tumors decreased only slightly [29].

Except for the Dutch study, most studies including the present study indicate a grade shift towards higher grading [25,28,27]. Several studies confirmed a trend towards higher grading such that pathologists have been shown to assign higher grades to the same tumors in the early 2000s compared to the 1990s [31]. In 2005, the GS grading system was revised and adapted by the International Society of Urological Pathology in order to reflect changes in the detection of prostate cancer, including PSA screening, methods of obtaining prostate tissue, immunohistochemistry, etc. [32,33]. The detailed modifications in the GS system are summarized in Epstein et al. (2005) [33].

Strengths and limitations

Strengths of the study are the relatively large sample size, the relatively long observation period (18 years) and the generally good quality of data collection in these two cantonal Swiss cancer registries as reflected by the low proportion of DCO cases and the high proportion of MV cases. However, T-stage and grade information are incomplete, but the percentage of cases with missing information decreased over time. The availability of either pathological or clinical T-stage increased from 27.8% to 94.9% in Zurich and from 45.2% to 89.0% in Ticino between 1996 and 2013. Grade was missing if only clinical data (and no pathological data) was available. Furthermore, stage and grade were sometimes not entered into the database due to limited resources, especially in earlier years. Finally, the sample size of our study did not allow for stratifying cancer stage into subcategories.

Conclusions

In 1996, the incidence of prostate cancer was higher in Zurich compared to Ticino, but due to a steeper increase in Ticino, the difference was smaller in 2013. Furthermore, the overall trends were similar in both cantons with an increase in the early phase of the observed period and a decrease in the later phase. Incidence increased until 2002 in Zurich and until 2007 in Ticino and decreased thereafter. The time lag in Ticino may be correlated with the different use of opportunistic screening. The stratified analyses did not reveal systematic differences between the two cantons, except for a different T-stage distribution with a higher proportion of T-stage 1 cancer cases in Zurich than in Ticino, which may also reflect the different opportunistic screening patterns. Further analyses including other Swiss regions and information regarding

lifestyle and screening patterns may help to understand the different magnitude in incidence rates.

Conflict of interest

The authors declare that they have no conflict of interest.

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Figure Captions

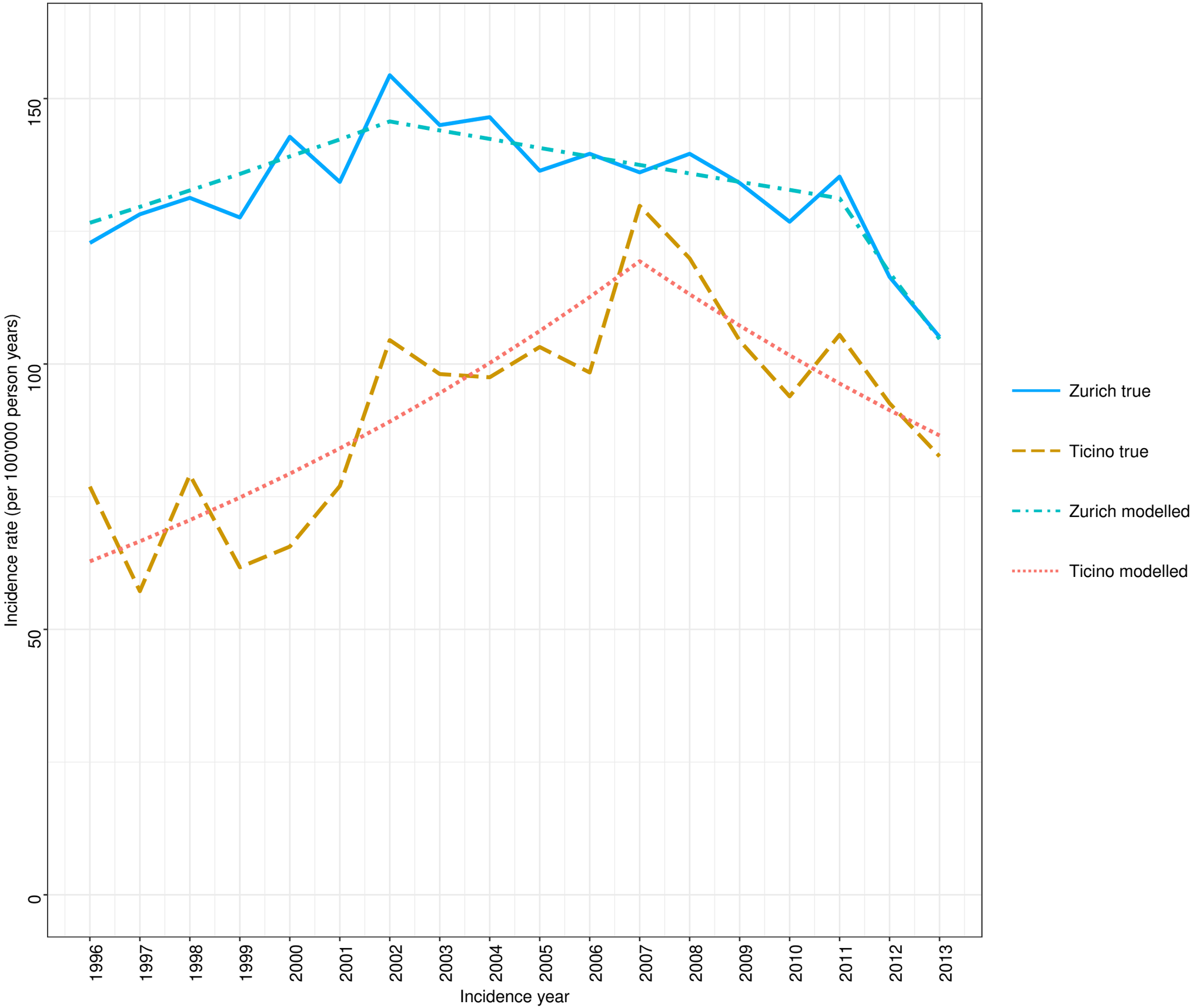
Fig. 1 Age-standardized incidence rates for prostate cancer 1996-2013, Zurich and Ticino (Switzerland).

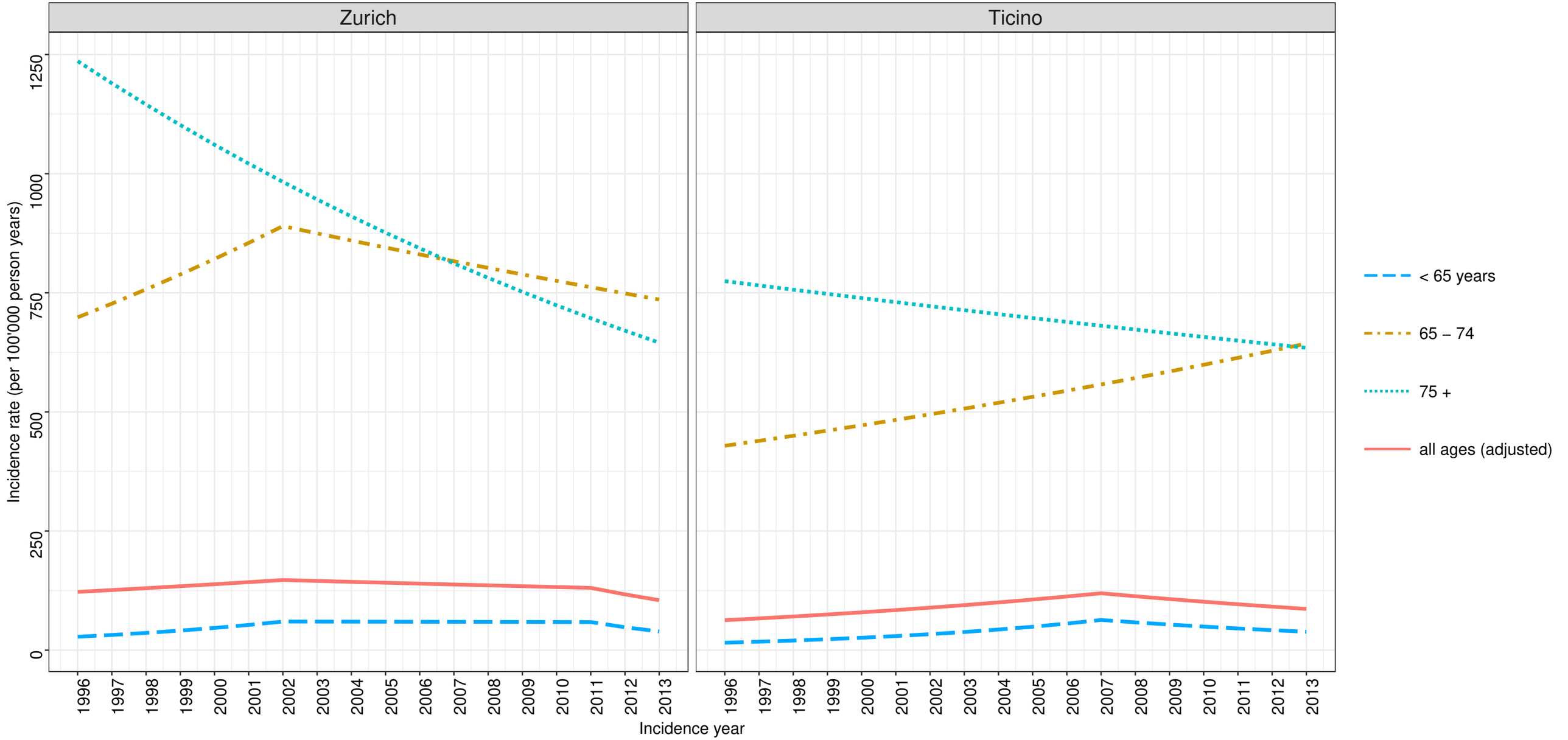
TI, Ticino; ZH, Zurich

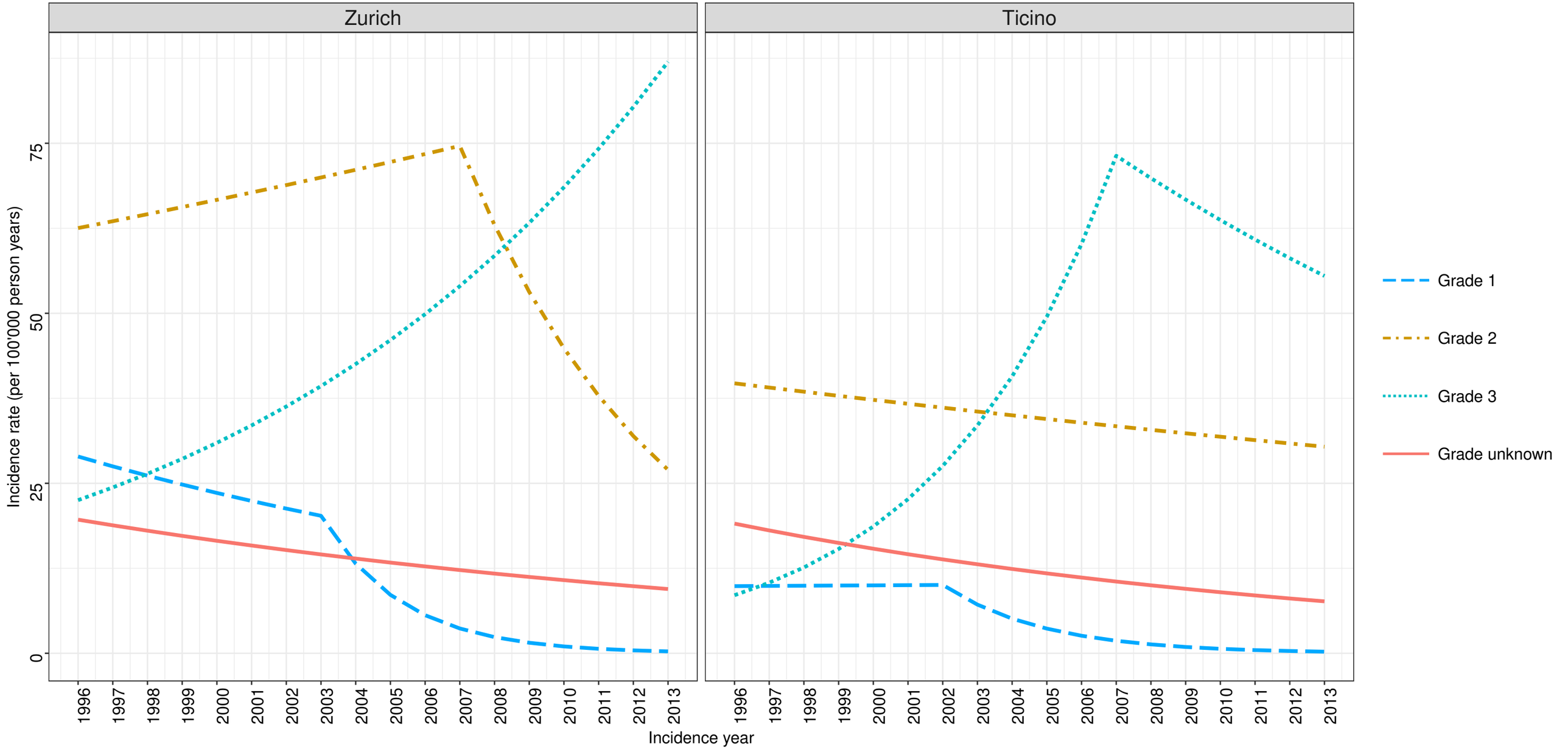
Fig. 2 Incidence rates of prostate cancer (per 100,000) modelled by joinpoint regression analysis according to age group, 1996-2013, Zurich and Ticino (Switzerland).

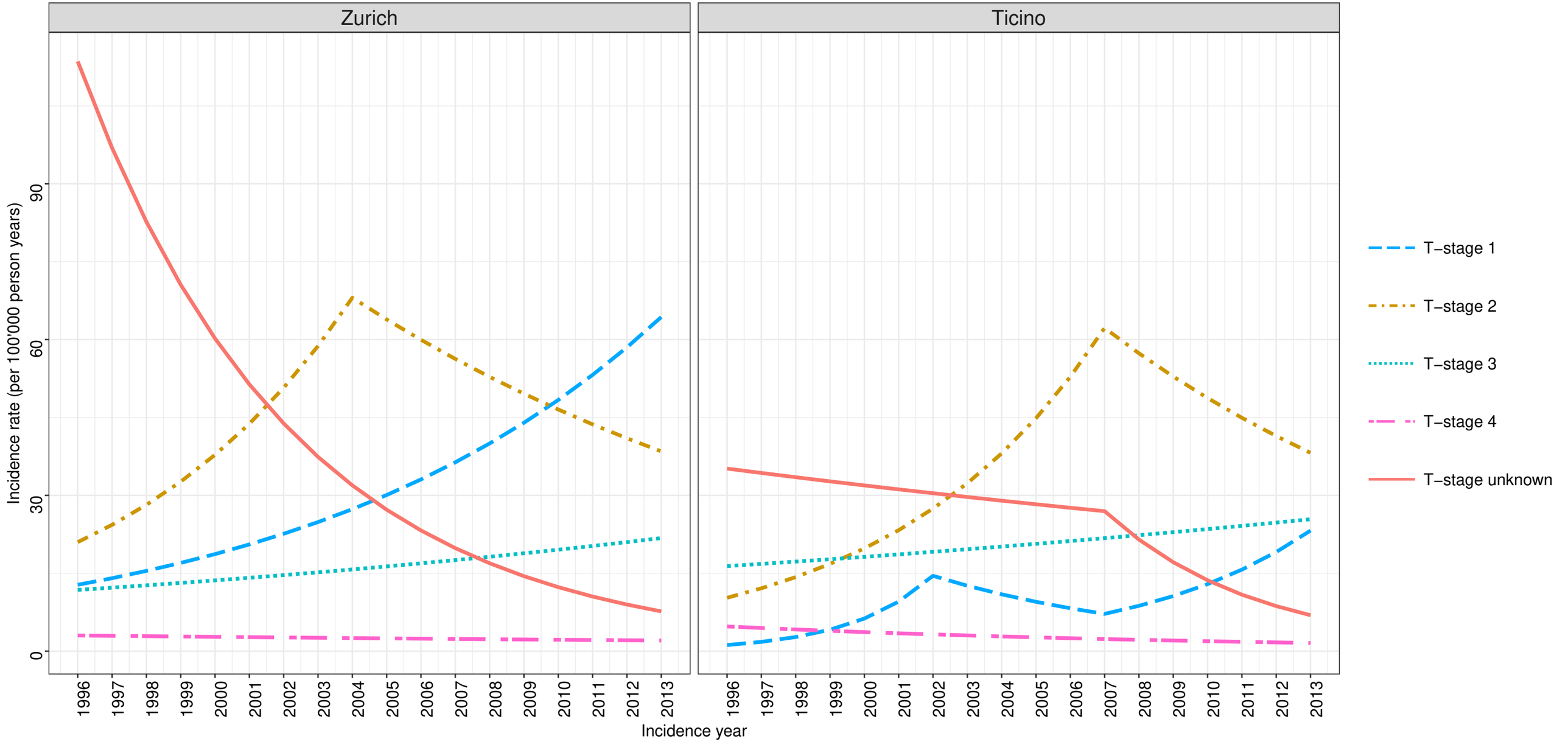
Fig. 3 Age-standardized incidence rates of prostate cancer (per 100,000) modelled by joinpoint regression analysis according to grade, 1996-2013, Zurich and Ticino (Switzerland).

Fig. 4 Age-standardized incidence rates of prostate cancer (per 100,000) modelled by joinpoint regression analysis according to T-stage, 1996-2013, Zurich and Ticino (Switzerland).


Incidence rate (per 100'000 person years)
0
50
100
150
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
Incidence year
Zurich true
Ticino true
Zurich modelled
Ticino modelled


Zurich
Ticino
Incidence rate (per 100'000 person years)
0
250
500
750
1000
1250
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
Incidence year
< 65 years
65 – 74
75 +
all ages (adjusted)


Zurich
Ticino
Incidence rate (per 100'000 person years)
0
25
50
75
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
Incidence year
Grade 1
Grade 2
Grade 3
Grade unknown


Zurich
Ticino
Incidence rate (per 100'000 person years)
0
30
60
90
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
Incidence year
T−stage 1
T−stage 2
T−stage 3
T−stage 4
T−stage unknown

Trends in prostate cancer incidence between 1996 and 2013 in two Swiss regions by age, grade and T-stage

Cancer Causes and Control

Miriam Wanner, Aline Richard, Katarina Matthes, Laura Ortelli, Matthias Lorez, Dimitri Korol, Andrea Bordoni, Sabine Rohrmann

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Electronic Supplementary Material Table 1. Prostate cancer incidence in Zurich and Ticino from 1996 to 2013. Number of cases, crude incidence rate (CR), age-standardized incidence rate (ASR) per 100,000 (using the 1976 European Standard Population) and age-stratified incidence rates (<65 years, 65-74 years, ≥75 years)

	Canton of Zurich							Canton of Ticino						
Year	**N**	**population**	**CR**	**ASR**	**<65years**	**65-74 years**	**≥75 years**	**N**	**population**	**CR**	**ASR**	**<65 years**	**65-74 years**	**≥75 years**
1996	771	572,197	134.7	122.8	28.2	728.6	1182.6	135	145,905	92.5	76.9	22.1	355.1	868.1
1997	815	574,084	142.0	128.2	33.9	749.5	1172.1	103	145,957	70.6	57.2	7.1	350.8	682.3
1998	846	576,616	146.7	131.3	35.2	751.0	1219.2	142	146,243	97.1	79.1	22.9	428.6	782.0
1999	839	581,310	144.3	127.6	39.5	685.2	1173.6	114	146,912	77.6	61.7	18.2	333.6	620.1
2000	945	587,977	160.7	142.8	46.3	857.2	1106.6	125	147,925	84.5	65.6	15.7	362.8	713.0
2001	903	595,174	151.7	134.3	50.7	804.9	894.6	148	148,214	99.9	77.0	19.7	451.2	754.5
2002	1059	603,460	175.5	154.4	59.7	925.0	1011.8	202	149,441	135.2	104.5	44.0	642.5	687.2
2003	1015	609,422	166.6	145.0	58.4	866.3	934.7	192	150,816	127.3	98.1	43.7	665.4	494.3
2004	1043	614,922	169.6	146.5	62.5	875.6	891.6	198	152,149	130.1	97.5	44.3	487.5	771.8
2005	993	621,163	159.9	136.4	62.0	788.5	820.2	216	153,586	140.6	103.2	48.7	594.4	685.1
2006	1037	627,127	165.4	139.6	60.2	844.3	842.5	214	154,960	138.1	98.4	53.2	455.6	760.1
2007	1036	636,784	162.7	136.1	61.8	806.4	797.4	285	156,674	181.9	129.8	66.6	683.7	872.1
2008	1089	650,426	167.4	139.6	59.4	857.8	827.0	271	158,875	170.6	119.9	52.3	751.5	743.3
2009	1072	662,381	161.8	134.1	56.3	827.4	793.0	241	160,815	149.9	104.4	57.2	545.3	659.9
2010	1031	671,844	153.5	126.8	55.2	771.3	716.7	224	162,800	137.6	93.9	42.5	557.7	613.5
2011	1106	683,914	161.7	135.3	60.5	831.0	688.2	254	162,650.5	156.2	105.5	48.7	613.7	694.2
2012	979	693,449	141.2	116.4	50.1	699.6	655.5	231	164,641.5	140.3	92.6	42.4	540.7	626.9
2013	916	702,322	130.4	105.1	38.2	682.1	650.6	210	167,159.5	125.6	82.6	39.0	512.9	493.9

ASR, age-standardized rate; CR, crude rate; N, number

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Electronic Supplementary Material Table 2. Specific parameters of the joinpoint analyses according to age group, grade and stage

	Overall trend		Trend 1		Joinpoint 1	Trend 2		Joinpoint 2	Trend 3	
	AAPC	95% CI	APC	95% CI		APC	95% CI		APC	95% CI
Zurich										
overall	-0.9	-2.1, 0.3	3.1	1.4, 5.0	2002	-1.3	-2.3, -0.3	2011	-10.5	-18.8, -1.2
<65 years	2.0	0.5, 3.5	13.5	10.9, 16.1	2002	-0.2	-1.3, 1.0	2011	-18.4	-27.5, -8.3
65-74 years	0.3	-1.0, 1.7	4.1	0.6, 7.8	2002	-1.7	-2.9, -0.5			
≥75 years	-3.8	-4.2, -3.3	-3.8	-4.2, -3.3						
Grade 1	-23.9	-27.7, -19.9	-5.0	-9.1, -0.7	2003	-34.8	-40.5, -28.6			
Grade 2	-4.8	-6.7, -2.9	1.6	-0.1, 3.4	2007	-15.6	-19.9, -11.1			
Grade 3	8.3	6.8, 9.8	8.3	6.8, 9.8						
Grade unknown	-4.2	-7.9, -0.4	-4.2	-7.9, -0.4						
Stage 1	10.0	6.4, 13.7	10.0	6.4, 13.7						
Stage 2	3.6	0.2, 7.1	15.8	8.6, 23.5	2004	-6.1	-9.7, -2.4			
Stage 3	3.7	2.1, 5.3	3.7	2.1, 5.3						
Stage 4	-2.3	-5.3, 0.9	-2.3	-5.3, 0.9						
Stage unknown	-14.7	-17.9, -11.3	-14.7	-17.9, -11.3						
Ticino										
overall	1.9	-0.4, 4.2	6.0	3.3, 8.8	2007	-5.2	-10.1, -0.1			
<65 years	5.5	1.0, 10.1	13.6	7.9, 19.6	2007	-7.9	-16.4, 1.5			
65-74 years	2.4	0.3, 4.6	2.4	0.3, 4.6						
≥75 years	-1.2	-2.5, 0.2	-1.2	-2.5, 0.2						
Grade 1	-19.7	-26.6, -12.0	0.3	-10.0, 11.8	2002	-28.8	-38.3, -17.9			
Grade 2	-1.6	-3.5, 0.5	-1.6	-3.5, 0.5						
Grade 3	11.6	7.2, 16.3	21.6	15.0, 28.5	2007	-4.5	-11.5, 3.0			
Grade unknown	-5.2	-9.2, -1.1	-5.2	-9.2, -1.1						
Stage 1	19.2	4.9, 35.4	52.0	10.6, 108.9	2002	-13.1	-34.4, 15.0	2007	21.6	8.0, 36.9
Stage 2	8.0	3.6, 12.6	17.8	11.6, 24.3	2007	-7.8	-15.3, 0.3			
Stage 3	2.6	0.0, 5.3	2.6	0.0, 5.3						
Stage 4	-6.3	-9.4, -3.0	-6.3	-9.4, -3.0						
Stage unknown	-9.1	-12.4, -5.7	-2.4	-5.1, 0.4	2007	-20.3	-28.1, -11.7			

APC, annual percent change; AAPC, average annual percent change, 95% CI, 95% confidence interval